



# The influence of living along the U.S.–Mexico border on unintentional drug overdose death, New Mexico (USA), 2005–2009

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## ABSTRACT

**Background:** The objective of this study was to characterize unintentional drug overdose death patterns among Hispanic ethnicity/sex strata by residence in New Mexico counties that border Mexico and non-border counties.

**Methods:** We analyzed medical examiner data for all unintentional drug overdose death in New Mexico during 2005–2009. Logistic and Poisson regression was used to examine the relationship of unintentional drug overdose death with border residence and demographics. Risk of overdose death was examined by the interactions of ethnicity, sex and border residence.

**Results:** During 2005–2009, the statewide drug overdose death rate was 17.6 per 100,000 ( $n = 1812$ ). Border decedents were more likely to have died from overdose of prescription opioids other than methadone (Schedule II, Adjusted Odds Ratio (aOR) = 1.98; Schedule III/IV, aOR = 1.56) but less likely to have died from heroin overdose (aOR = 0.35), compared to non-border decedents. In population-based analyses, people living in border counties had lowest rates of overall overdose death and from illicit drugs, particularly heroin and cocaine. Hispanic males (adjusted incidence rate ratio [aRR] = 2.41), Hispanic females (aRR = 1.77) and non-Hispanic males (aRR = 1.37) from non-border counties had higher risk of drug overdose death than their counterparts from border counties. Border residence had no effect on risk of drug overdose death among non-Hispanic females.

**Conclusions:** Residents in border counties incurred a protective effect for drug overdose death, most pronounced among Hispanics. There is a component of overdose death risk for which border residence is a proxy, likely an array of cultural and healthcare-related factors.

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## 1. Introduction

The U.S. state of New Mexico has 180 miles bordering Mexico, or 9% of the total length of the U.S.–Mexico border, most of which is open, uninhabited desert. Due in part to proximity to Mexico, 28% of New Mexicans speak Spanish at home, the second highest percentage among U.S. states, and roughly 10% of New Mexicans are foreign-born (Census Bureau, 2007–2009). As with any international border, the population of the U.S.–Mexico border region may represent a cultural group in the middle of the two nations, with unique health needs and perspectives.

Significant U.S.–Mexico border issues related to health system factors and differential access to preventive care, screening, chronic and infectious disease management, and behavioral health services,

among others, continue to be addressed. Specific concerns about drug trafficking and its effect have emerged as a major health threat in the border area, associated with high rates of homicide, violence and crime. In 2009, there were 2082 drug-related killings in the bordering Mexican state of Chihuahua, location of the key drug trafficking Juárez corridor, accounting for 31% of all drug-related homicides in Mexico (National Drug Intelligence Center, 2011). The impact of this drug-related unrest in Mexico upon life on the U.S. side of the border is poorly understood. It is important to monitor the health status of vulnerable border populations as the situation will likely improve only gradually. Drug overdose death is a severe, measurable consequence associated with this problem.

In 2008, New Mexico had the highest drug overdose death rate (any intent) in the U.S. of 27.0 deaths per 100,000 (Centers for Disease Control and Prevention, 2011a). Illicit drug use is widespread and prescription drug overdose death rates have increased in recent years, compounding the already severe consequences from illicit drug use (Centers for Disease Control and Prevention, 2005; Mueller et al., 2006; Shah et al., 2008). This study

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aims to characterize unintentional drug overdose death by border resident status in New Mexico. We hypothesize that there are different overdose death patterns for residents in border counties relative to non-border counties, and these differences may vary according to sex and Hispanic ethnicity. Medical examiner records were analyzed from 2005 through 2009 to: (1) determine whether decedent characteristics and overdose pattern differed by residence in border and non-border counties, and (2) identify population-level patterns in drug overdose death by border resident status and ethnicity/sex strata.

## 2. Methods

### 2.1. Medical examiner methods and outcome

All cases of unintentional drug overdose death were identified from 2005 through 2009 using an electronic database provided by the New Mexico Office of the Medical Investigator (OMI). The OMI jurisdiction included all deaths in New Mexico that were sudden, unexplained, violent or untimely, with the exception of those that occur on federal or tribal land. However, the OMI was contracted to investigate some of those deaths as well (roughly 10% of autopsies annually). For deaths suspected of being due to the effect of drugs or poisons, a full autopsy was carried out, samples were screened for drugs of abuse and those with positive results were confirmed with additional tests. OMI board-certified forensic pathologists consulted with toxicologists in case evaluations. When individuals died from toxic substances after a period of hospitalization, OMI procured antemortem specimens, when available, from the health care facility for toxicological testing.

Classification for cause of death was determined by OMI pathologists and was not simply a determination of the presence or absence of a drug in a toxicologic screen. The diagnosis of drug overdose death and manner of death classification was dependent on the autopsy, circumstances of death, scene investigation, medical records and blood concentration levels of one or more drugs, with or without alcohol, as determined by the pathologist.

Toxicology for the metabolite(s) or drug(s) causing death is largely straightforward, except that the main metabolites for heroin, morphine and codeine are similar and required additional coding for categorization. Heroin-caused overdose death was diagnosed by the presence of 6-monoacetylmorphine (6-MAM) and/or morphine, along with information from the OMI investigation. In general, heroin-caused death was diagnosed when a lethal blood concentration level of 6-MAM was found. When morphine blood concentration level was found without 6-MAM, OMI may have concluded that heroin was the cause of overdose death after considering all available information (i.e., paraphernalia/heroin at scene, track marks, history of use). The finding of morphine blood concentration in a decedent was classified as a morphine-caused death if the differentiation between heroin- and morphine-caused death was not definitive. Similarly, codeine was classified as a cause of death only when a lethal level of the metabolite was indicated in the absence of heroin and morphine.

### 2.2. Covariates of interest

The border region was defined as a New Mexico county within 100 km of the U.S.-Mexico border (Hidalgo, Grant, Luna, Sierra, Doña Ana and Otero counties; 17% of state population). The remaining 27 counties were classified as the non-border region (Fig. 1).

The demographic covariates of interest were Hispanic ethnicity and sex, and models were adjusted for age. With ethnicity, white race was dichotomized into white Hispanic and white non-Hispanic. The Hispanic covariate was examined as white

Hispanic versus everyone else, subsequently referred to as Hispanic versus non-Hispanic. The non-Hispanic grouping was mostly white (74%) and the remaining proportion was American Indian (19%), black (4%) and Asian race (3%). Non-mutually exclusive drug categories examined were heroin, cocaine, methamphetamine, methadone, prescription opioids other than methadone, tranquilizers and muscle relaxants (i.e., benzodiazepines), antidepressants and the combination of drugs and alcohol. Methadone was examined separately from other prescription opioids because of its dual purpose in opiate replacement therapy and pain management. Controlled Substances Schedule II opioids other than methadone were oxycodone, fentanyl, hydromorphone, morphine, oxymorphone, levorphanol and meperidine. Schedule III/IV opioids were propoxyphene, codeine formulations, hydrocodone and pentazocine.

### 2.3. Statistical analysis

Bivariate and multivariate analyses were performed. For decedents,  $\chi^2$  tests were used to compare categorical covariates and the Wilcoxon rank-sum test was used to analyze continuous age. Logistic regression was used to assess the association of type of drug overdose death and decedent border residence status, adjusting for age, ethnicity and sex. For the population-based analysis, rates of unintentional drug overdose death were calculated for the drugs causing overdose death in New Mexico and averaged over the five-year period. Total and drug-specific death rates were calculated, age-adjusted to the 2000 U.S. standard population and expressed per 100,000 person-years. The population denominator for rate calculations was 2007, the middle year of the study period. Poisson regression was used to examine risk of drug overdose death and the main effects of border residence, ethnicity and sex, adjusting for age. Lastly, the interactions of residence in border counties, ethnicity and sex (three interaction terms) were examined and interpreted as eight strata: border Hispanic male, border Hispanic female, border non-Hispanic male, border non-Hispanic female, non-border Hispanic male, non-border Hispanic female, non-border non-Hispanic male and non-border non-Hispanic female. The covariate effects were expressed as odds ratios (OR) for logistic models and incidence rate ratios (RR) for Poisson models, with 95% confidence intervals (95% CI). An alternative model for overdispersed Poisson distribution was also performed, resulting in very similar estimates.

The population denominator was from the Bureau of Business and Economic Research (BBER), University of New Mexico rather than the U.S. Census Bureau. It was thought that the Census Bureau postcensal population estimates for New Mexico were undercounts due to methodology, so BBER was state-funded in 2004 to address this inadequacy. The BBER method utilized data sources such as birth and death records, building permits, motor vehicle records and housing records (including prefabricated housing), believed to result in more accurate postcensal population estimates for New Mexico. In 2007, New Mexico had roughly 2.05 million people; 49% male, 43% white (non-Hispanic), 41% Hispanic, 11% American Indian, 3% black and 2% Asian/Pacific Islander race. The Hispanic population was 53% in border counties and 39% in non-border counties.

## 3. Results

### 3.1. Decedent characteristics

During 2005–2009, there were 1876 unintentional drug overdose deaths investigated by the New Mexico OMI. Sixty-four (3.4%) decedents did not reside in New Mexico. This analysis included

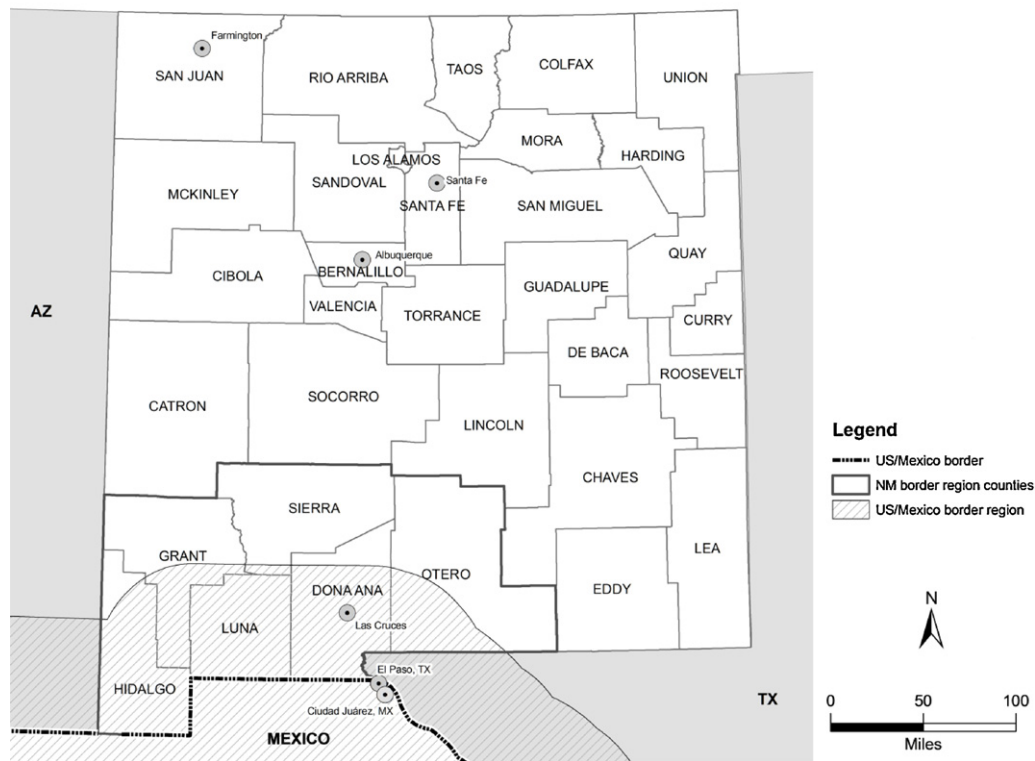


Fig. 1. New Mexico border and non-border counties, U.S.-Mexico International border region.

1812 unintentional drug overdose deaths among New Mexico residents who died in New Mexico between 2005 and 2009 (17.6 deaths per 100,000 persons). Thirty-one percent were female, 48% were Hispanic, 46% were white (non-Hispanic), and 3% were each of American Indian and other race (black and Asian). The median age of decedents was 43.7 years of age (1st, 3rd interquartile range: 33.1, 50.8). One-third of decedents died on a weekend and 83% died between 11 PM and 7 AM.

Ninety-three percent ( $n=1680$ ) of decedents had toxicology for the drug(s) causing death. Seventy-three percent of deaths were caused by multiple drugs and 27.6% were caused by the combined effect of drugs and alcohol. Heroin caused death most often (36.1%), followed by cocaine (31.3%). Nearly 30% of overdose deaths were caused by tranquilizer/muscle relaxants, 28.0% were caused by Schedule II opioids other than methadone, 16.5% were caused by antidepressants, 16.2% were caused by Schedule III/IV opioids, 14.2% were caused by methadone and 9.5% were caused by methamphetamine. These categories were not mutually exclusive where the drug(s) caused overdose death either alone or in combination with other substances.

### 3.2. Decedent border residence and type of overdose death

Decedent demographics were compared by region of residence. Table 1 shows decedent characteristics statewide and by border residence. Even though there was a larger Hispanic population in the border region than non-border region, there was a smaller proportion of Hispanic overdose decedents in the border region compared to the non-border region (41.7% and 48.3%;  $p=0.07$ ).

Table 1 shows bivariate and multivariate correlates of overdose by decedent border resident status. Compared to decedents from the non-border counties, a larger proportion of decedents from border counties died from an overdose caused by prescription drug(s) (72.3% and 59.2%;  $p<0.001$ ) while a smaller proportion died from an overdose caused by illicit drug(s) (45.0% and 62.5%;  $p<0.001$ ).

Specifically, a larger proportion of border overdose decedents died from prescription opioids (63.4% and 46.9%;  $p<0.001$ ) and tranquilizers/muscle relaxants (35.1% and 28.3%;  $p=0.05$ ), compared to non-border decedents. A smaller proportion of border decedents died from heroin, compared to non-border decedents (17.3% and 38.6%;  $p<0.001$ ).

Compared to non-border decedents, logistic regression models adjusting for age, sex and ethnicity showed that border decedents overdosed more often from Schedule II opioids other than methadone (adjusted odds ratio (aOR)=1.98; 95%CI: 1.44, 2.71) and Schedule III/IV opioids (aOR=1.56; 95%CI: 1.08, 2.25), but overdosed less often from heroin (aOR=0.35; 95%CI: 0.23, 0.51; Table 1).

### 3.3. Population analysis of overdose death by border residence, ethnicity and sex

Fig. 2 shows age-adjusted death rates (with 95%CI bars) for type of overdose by border residence. Non-border residents had higher death rates for total unintentional drug overdose compared to border residents (18.6 per 100,000 and 12.8 per 100,000). Border residents had lower death rates from heroin, cocaine and combination of drugs and alcohol, compared to non-border residents (non-overlap of 95%CI). The age-adjusted death rates are shown in the corresponding table.

Table 2 shows the number and age-adjusted drug overdose death rates for the main covariates of border resident status, ethnicity and sex, and strata. The highest death rates were observed for males, Hispanics and residents in the non-border region. For the eight strata, the highest age-adjusted death rates were found for Hispanic males from the non-border region (36.0 per 100,000), followed by non-Hispanic males from the non-border region (19.9), non-Hispanic males from the border region (17.0), Hispanic males from the border region (15.6), non-Hispanic females from the border region (13.4), Hispanic females from the non-border region

**Table 1**  
Characteristics of unintentional drug overdose decedents with bivariate and multivariate associations by border residence: New Mexico (USA), 2005–2009.

	Total (n = 1812)	Border region (n = 216)	Non-border region (n = 1596)	P-value	Adjusted odds ratio (95% confidence intervals)
	%	%	%		
Female	31.4	38.0	30.4	0.026	
Race/ethnicity					
White (non-Hispanic)	46.0	54.6	44.8	0.007	
Hispanic	47.5	41.7	48.3	0.07	
American Indian	3.3	1.4	3.5	0.10	
Other (Black, Asian)	2.5	2.3	2.6	0.82	
Median age (1st, 3rd IQR)	43.7(33.1, 50.8)	44.3(32.8, 51.8)	43.6(33.2, 50.6)	0.48	
Age 60 + years	4.8	5.6	4.6	0.55	
Decedents with toxicology data	Total (n = 1680)	Border region (n = 191)	Non-border region (n = 1489)	P-value	Adjusted odds ratio (95% confidence intervals)
	%	%	%		
Type of overdose <sup>a</sup>					
Multiple drugs	72.5	72.3	72.5	0.93	0.97 (0.69, 1.36)
Any illicit drug	60.5	45.0	62.5	<0.001	0.52 (0.38, 0.71)
Any prescription drug	60.7	72.3	59.2	<0.001	1.69 (1.20, 2.37)
Heroin	36.1	17.3	38.6	<0.001	0.35 (0.23, 0.51)
Cocaine	31.3	26.2	32.0	0.10	0.80 (0.56, 1.13)
Methamphetamine	9.5	8.9	9.5	0.78	0.91 (0.53, 1.55)
Methadone	14.2	15.7	14.0	0.52	1.13 (0.74, 1.71)
Other Schedule II opioid	28.0	42.4	26.1	<0.001	1.98 (1.44, 2.71)
Schedule III/IV opioid	16.2	22.5	15.4	0.012	1.56 (1.08, 2.25)
Any prescription opioid	48.8	63.4	46.9	<0.001	1.86 (1.35, 2.55)
Tranquilizer/muscle relaxant	29.1	35.1	28.3	0.05	1.28 (0.93, 1.77)
Antidepressant	16.5	17.8	16.3	0.60	1.02 (0.68, 1.53)
Drug and alcohol combination	27.6	22.5	28.2	0.10	0.80 (0.55, 1.15)

Notes: Logistic regression models adjusted for age, sex and race/ethnicity.

<sup>a</sup> Not mutually exclusive; where the drug(s) may have caused death either alone or in combination with other substances.

**Table 2**  
Age-adjusted death rates and regression models for total unintentional drug overdose death: main effects and interaction model: New Mexico (USA), 2005–2009.

		Age-Adjusted death rate per 100,000 (95% confidence interval)	Adjusted incidence rate ratio (95% confidence intervals)
<i>Main effects model</i>			
Total		17.6 (16.8, 18.5)	
Male		12.2 (11.6, 13.0)	1.0
Female		5.4 (5.0, 5.9)	0.45 (0.43, 0.47)
Non-Hispanic		7.7 (7.2, 8.2)	1.0
Hispanic		10.4 (9.8, 11.2)	1.27 (1.20, 1.34)
Non-Border region		18.6 (17.7, 19.6)	1.0
Border region		12.8 (11.2, 14.8)	0.70 (0.65, 0.75)
	No. of deaths	Age-adjusted death rate per 100,000 (95% confidence interval)	Adjusted incidence rate ratio (95% confidence intervals)
<i>Interaction model<sup>a</sup></i>			
Non-border, non-Hispanic males	520	19.9 (18.2, 21.7)	1.0 (referent)
Non-border, non-Hispanic females	306	10.9 (9.7, 12.3)	0.48 (0.45, 0.50)
Non-border, Hispanic males	590	36.0 (33.1, 39.2)	1.55 (1.45, 1.65)
Non-border, Hispanic females	180	11.2 (9.6, 13.1)	0.47 (0.42, 0.52)
Border, non-Hispanic males	69	17.0 (13.1, 21.8)	0.73 (0.66, 0.80)
Border, non-Hispanic females	57	13.4 (10.1, 17.6)	0.47 (0.42, 0.53)
Border, Hispanic males	65	15.6 (12.0, 20.9)	0.64 (0.55, 0.75)
Border, Hispanic females	25	5.7 (3.7, 9.3)	0.26 (0.22, 0.32)

Notes: Main effects and interaction regression models adjusted for age.

<sup>a</sup> Risk of overdose death interpreted for each stratum with non-border, non-Hispanic males as reference group.

(11.2), non-Hispanic females from the non-border region (10.9) and Hispanic females from the border region (5.7).

The main effects model showed an increased risk of overdose death for Hispanics compared to non-Hispanics (adjusted

incidence rate ratio (aRR) = 1.27; 95%CI: 1.20, 1.34), while lower risk was found for females compared to males (aRR = 0.45; 95%CI: 0.43, 0.47) and border residents compared to non-border residents (aRR = 0.70; 95%CI: 0.65, 0.75).

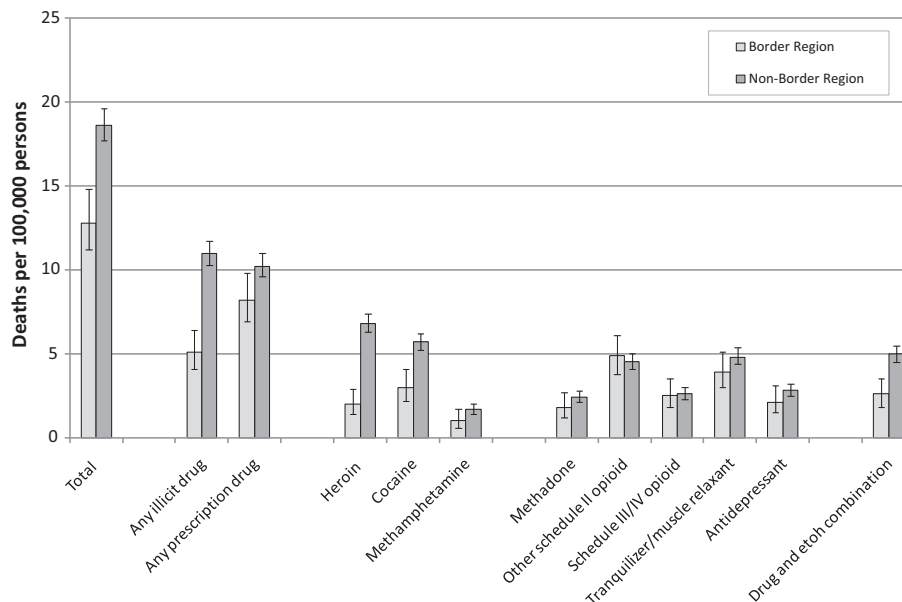
### 3.4. Interaction of border residence, ethnicity and sex

Also in Table 2, the interaction model showed the highest risk of overdose death for Hispanic males living in the non-border region, compared to non-Hispanic males living in the non-border region (aRR = 1.55; 95%CI: 1.45, 1.65). The following rate ratios were calculated from interaction model parameter estimates for the four non-border ethnicity/sex strata, with the border resident complement as the referent. Compared to their counterparts living in the border region, Hispanic males living in the non-border region had a 2.41 times higher risk of overdose death (95%CI: 2.05, 2.83), Hispanic females from the non-border region had a 1.77 times higher risk of overdose death (95%CI: 1.47, 2.14), non-Hispanic males from the non-border region had 1.37 times higher risk of overdose death (95%CI: 1.24, 1.52), and there was no increased risk of overdose death for non-Hispanic females from the non-border region (aRR = 1.01; 95%CI: 0.90, 1.14). Or, the inverse is that all ethnicity/sex strata living near the border, except non-Hispanic females, had significantly lower risk of drug overdose death compared to their counterpart living in the non-border region, adjusting for age.

The strongest protective effect for border residence was observed among Hispanic males.

## 4. Discussion

In New Mexico, residents living near the U.S.-Mexico border had reduced risk of dying from an unintentional drug overdose compared to residents living farther from the border. The degree of protective effect for border residence varied among subpopulations, with a more robust protective effect observed among Hispanics compared to non-Hispanics. Specifically, Hispanic male and Hispanic female non-border residents had 2.4 and 1.8 times higher risk of overdose death, respectively, than their counterparts living in border counties. This effect was modest among non-Hispanic males, 1.4 times higher risk of overdose death among non-border residents compared to border residents, while no effect was observed among non-Hispanic females. There were higher rates of overdose death from heroin, cocaine and drug and alcohol combinations among non-border residents than border residents. Although population rates for opioid overdose death were similar



Note. Rates are age-adjusted to the 2000 U.S. standard population; Error bars represent the 95% confidence interval for the age-adjusted incidence rate.

	Border Region (n=216)	Non-Border Region (n=1,596)
Type of overdose	Rate per 100,000 persons	Rate per 100,000 persons
Total (n=1,812)	12.8 (11.2, 14.8)	18.6 (17.7, 19.6)
<i>Decedents with toxicology data</i>		
	n=191	n=1,489
Any illicit drug	5.1 (4.1, 6.4)	11.0 (10.3, 11.7)
Any prescription drug	8.2 (6.9, 9.8)	10.2 (9.6, 11.0)
Heroin	2.0 (1.4, 2.9)	6.8 (6.3, 7.4)
Cocaine	3.0 (2.2, 4.1)	5.7 (5.2, 6.2)
Methamphetamine	1.0 (0.6, 1.7)	1.7 (1.4, 2.0)
Methadone	1.8 (1.2, 2.7)	2.4 (2.1, 2.8)
Other schedule II opioid	4.9 (3.8, 6.1)	4.5 (4.1, 5.0)
Schedule III/IV opioid	2.5 (1.8, 3.5)	2.6 (2.3, 3.0)
Tranquilizer/Muscle relaxant	3.9 (3.0, 5.1)	4.8 (4.4, 5.4)
Antidepressant	2.1 (1.5, 3.1)	2.8 (2.5, 3.2)
Drug and alcohol combination	2.6 (1.8, 3.5)	5.0 (4.5, 5.5)

Notes: The drugs causing death are not mutually exclusive, where the drug(s) may have caused death either alone or in combination with other substances.

Fig. 2. Age-adjusted rates of unintentional drug overdose death by type of overdose and border residence: New Mexico (USA), 2005–2009 (with accompanying table).



in both regions, overdose death from opioids other than methadone was 1.9 times more common among border decedents than non-border decedents. This study confirms prior research that Hispanics and males have the highest unintentional drug overdose death rates in New Mexico (Shah et al., 2008). However, prior studies did not examine geographic location. We can hypothesize about the factors that may lead to decreased risk of overdose death among border residents and potential explanations for differential findings by ethnicity.

Well-documented research has described the influence of societal determinants on patterns of health care utilization in the U.S. An unexpected but logical rationale is that ethnic disparities in health care access may result in a favorable population-level outcome concerning prescription drug overdose death. The border region, as defined in this analysis, was 53% Hispanic compared to 39% in the rest of the state. It is estimated that 25–29% of Hispanics in New Mexico lack health insurance, 61% of foreign-born and 17% of native-born, an overall rate of uninsured that is twice that of non-Hispanic whites in New Mexico (12–13%; *Pew Hispanic Center, 2009; New Mexico Department of Health, 2011*). Compared to white non-Hispanics, studies show that Hispanics are less likely to be prescribed analgesic drugs or of sufficient strength to manage pain (Todd et al., 1993; Ng et al., 1996; Cleeland et al., 1997; Anderson et al., 2000; Paulson and Dekker, 2005; Olsen et al., 2006; Pletcher et al., 2008), have higher rates of medication non-adherence (i.e., due to cost, lack of insurance) (Gellad et al., 2007; Lanouette et al., 2009), lower quality of care (Fiscella et al., 2003), and preference for traditional healing and alternative medicine to conventional medicine (Fishman et al., 1993; Keegan, 2000; Padilla et al., 2001; Gomberg, 2003; Kelly et al., 2006), all of which could result in lower rates of prescription drug utilization. For Hispanics, the unintended result might be reduced “exposure” to potent medications and consequently, lower risk of overdose from these drugs.

The effect of such factors may be accentuated among recent Hispanic immigrants compared to Hispanic families who settled generations ago. Recent immigrants from Mexico entering the workforce might remain outside of the U.S. health care system as they are young, healthy and have neither need to access services (Livingston et al., 2008) nor the motivation to deal with a complicated and unfamiliar system (Nandi et al., 2008). They may also experience lower rates of substance abuse and overdose than more acculturated Hispanic immigrants (Burnam et al., 1987; Amaro et al., 1990; Wagner-Echeagaray et al., 1994; Vega et al., 1998, 2003; Ortega et al., 2000; Cherpitel and Borges, 2002; Gfroerer and Tan, 2003). During the study period, there was a slightly larger proportion of recent immigrants in the border area than non-border area (3.2% of population entering U.S. in 2000 or later, versus 2.5%; *Census Bureau, 2005–2009*), as the border serves as a “staging” area where immigrants temporarily reside until they can transition to other destinations. As with overdose death, rates of total and cause-specific injury death due to falls, motor vehicle crashes, homicide, and suicide, were also lower among border Hispanics compared to non-border Hispanics in New Mexico during 2005–2007 (*WISQARS, Centers for Disease Control and Prevention*). It would be informative to identify the regional socio-cultural characteristics among Hispanics, including immigration recency, that influence drug overdose death patterns, and explore the existence of such effects for other health outcomes.

Although age was not examined in the analysis, population age structure should be considered in this context. New Mexico population data (2007) showed equal proportions of Hispanics aged 60 years and older living in both regions (12%). As previously described, aging Hispanics, especially those living near the border with low acculturation and strong ties to Mexico, may differ from their respective non-Hispanic cohort in terms of attitudes and health-related behaviors, some of which may decrease their risk

of drug overdose. Compared to other racial/ethnic groups, studies among Hispanic elderly show lower insurance coverage (Choi, 2011), less prescription drug utilization (Xu and Borders, 2007), language barrier to health care access (Cheng et al., 2007; Sentell et al., 2007; Kim et al., 2011), preference for alternative treatment (Loera et al., 2001) and differing behaviors concerning home health care (Kirby and Lau, 2010).

The subset of non-Hispanics aged 60 years and older was 25% of the border region population and 20% of the non-border region population, implying an older population age structure for non-Hispanics living in the New Mexico border region. There was a preponderance of overdose death from opioids other than methadone among New Mexico border decedents during 2005–2009, perhaps driven by overdose death among non-Hispanic females since the reduced risk effect of border residence was not observed among this subpopulation as with other groups. This detail for drug-specific overdose death by subpopulation and geographic residence is beyond the scope of this analysis, but essential in understanding the regional problem. National trends during the last decade show high rates of opioid abuse and overdose death among middle-aged persons, whites and females (Cicero et al., 2005; *Centers for Disease Control and Prevention, 2011a*). Overdose risk is rising among baby boomers who require medications for chronic pain and multi-morbid conditions, where there is particularly high risk for those with history of substance abuse or mental illness. Currently, this predicament likely affects the non-Hispanic, non-immigrant population to the greatest extent. As U.S. policy evolves to address disparities in health care access and providers become more educated about the issue, we urge that standards for patient safety and proven and promising interventions for medication overdose are innovated and adapted according to risk patterns among subpopulations and with cultural competence.

Finally, the effect of border residence on overdose death is likely associated with the availability of heroin, which is relatively pure in New Mexico (Cunningham et al., 2010). Heroin caused 36% of all unintentional drug overdose deaths in New Mexico during the study period and remains a major concern in the state. The prevalence of heroin use is highest in the Albuquerque area and northern New Mexico. The most populous New Mexico city in the border area is Las Cruces, located near the junction of El Paso, Texas and Ciudad Juárez, Mexico, and second to Albuquerque as the largest metropolitan area in New Mexico (Fig. 1). During the study period, law enforcement intelligence reported the wholesale price of heroin (black tar and brown powder) in Las Cruces was almost double the price compared to Albuquerque/northern New Mexico, where demand is highest (personal communication, New Mexico Investigative Support Center). It is likely that heroin is less available in the border region because of low demand and low prevalence of use. Consequently, the contribution of heroin to total drug overdose death was lowest among people living near the border, 16% compared to 37% among non-border residents. The most disparate overdose death rates by border residence were also found for heroin (rate ratio of 3.4), among all drug types. Lastly, overdose death among Hispanic male drug users who live in these areas of high prevalence drives the disproportionately high rate among this subpopulation, more than twice the rate of Hispanic males living in the border region (36.0 per 100,000 and 15.6 per 100,000, respectively), and magnifies the overall disparity in overdose death by border residence. Demand reduction must be recognized as the cornerstone in the ongoing effort to reduce drug abuse and its negative consequences. Particularly in U.S. border states, drugs that are brought into the U.S. may be in greater quantity and more accessible before transportation (to other cities), when the probability of interdiction increases. Informed enforcement strategy related to supply reduction is an important partner in the effort to reduce drug demand.

There are some study limitations. The tradition of drug use in New Mexico is unique, endemic and intergenerational in some parts, so results of this study may not be generalizable. Increasing the number of events (i.e., more years of data) would improve rate stability for strata with small numbers. The extent to which U.S. residents obtain controlled substances in Mexican pharmacies, and whether this behavior differs by demographics and geographic residence, is a potential overdose risk factor that needs clarification. Lastly, New Mexico residence was ascertained by the OMI through driver's license or next of kin. OMI does not routinely check the citizenship status of decedents in its jurisdiction, thus precluding analysis of data on citizenship status or immigration recency in this study.

In summary, the effect of border residence and reduced risk of overdose death was clear among Hispanics, and to a lesser extent for non-Hispanics. Perhaps there is less variation in drug overdose death risk factors among non-Hispanics in the border and non-border region, or at least not as heterogeneous as their Hispanic counterparts. Nevertheless, the finding of reduced risk among border residents is noteworthy, where the overdose death rate among people living in the border region during the study period was near the national rate (12.8 per 100,000 versus 2007 U.S. unintentional/undetermined drug overdose death rate of 10.3 per 100,000; [National Center for Health Statistics](#)); the statewide unintentional drug overdose death rate has been roughly twice that of the U.S. for the past two decades. This suggests that there is a legitimate component of overdose death risk for which border residence is a proxy, likely a complex array of factors that affect drug use initiation, behavior and overdose. The fields of drug abuse and overdose prevention aim to implement effective strategies for risk reduction, but also identify and promote protective influences when possible. These findings can be considered a broad characterization of a phenomenon that should be further investigated in order to develop the most appropriate demographic-specific prevention, treatment and harm reduction efforts.

In addition to clarifying the drug-specific overdose patterns by subpopulation and geographic residence, the following are recommended: (1) enhance knowledge of the paradoxical factors that influence substance use and drug overdose among Hispanic subgroups, such as acculturation, religiosity/spirituality, family cohesion and health behaviors (i.e., "healthy immigrant effect"), so that delivery of services can be improved and prevention programs tailored to strengthen families and communities; (2) ensure practitioners and policymakers continue development of culturally appropriate medication overdose prevention strategies; (3) expand availability and options for medication-assisted treatment (i.e., buprenorphine) to reach underserved populations and those with poor treatment outcomes with methadone; and (4) establish whether other U.S. states experience differing overdose death patterns in areas near to the international border and specifically, whether U.S.-Mexico border regions observe similar protective effect of U.S. border residence on drug overdose death.

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### Contributors

Nina Shah conceptualized the study, conducted the analysis, interpreted findings and wrote the paper. Sarah Lathrop, Janet Flores and Mike Landen provided feedback on methodology and critical review of drafts during development. All authors approved the final version.

### Conflict of interest

All authors declare that there are no conflicts of interest.

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